

Application No. 09/982,963
Response dated October 24, 2003
Reply to Office Action of July 11, 2003

REMARKS

Claims 1-15 are pending in this application, of which claims 9-15 have been withdrawn from consideration. Reconsideration of the rejections in view of the following remarks is respectfully requested.

Examiner Interview

Applicant appreciates the Examiners' courtesies extended during the interview on October 14, 2003.

In the interview, explanation of the technology and the distinction between the present invention and the prior art was made. It was agreed that because “Bertin et al. does not teach the piercing hole has a first diameter in the insulating film and a second diameter in the semiconductor substrate which is wider than the first diameter,” there is no suggestion or motivation to apply the teaching of Bertin et al. to semiconductor device which has the piercing hole has such a first diameter and a second diameter.

The substance of the interview is reflected in the remarks below.

Rejections under 35 U.S.C. §103(a)

Claims 1, 4, 5 and 8 were rejected under 35 U.S.C. §103(a) as being obvious over Bertin et al. (U.S. Patent No. 6,222,276).

Applicant respectfully traverses this rejection.

Claims 1 and 5 recite “wherein the piercing hole is formed by using the insulating film as an etching mask,” and “an insulating film sleeve lies only between the piercing electrode and an inside wall of the piercing hole in the semiconductor substrate.”

As described at page 10, line 29 – page 11, line 35 of the present application, the silicon substrate 41 is etched at the opening part 43C by reactive ion etching (RIE) method. A sulfur fluoride gas and a hydrocarbon gas are used reciprocally in the RIE method. As a result, a concave part 41C is formed in the silicon substrate 41 as corresponding to the opening part 43C. The concave part 41C extends in an almost perpendicular direction against a main surface of the silicon substrate 41. The silicon dioxide film 43 is used as a hard mask and the etching is selectively done in the silicon substrate 41. During the etching, the concave part 41C expands to a side direction, so that the concave part 41C has a bigger diameter than the diameter of the opening part 43C. Then, a space 45A is formed in the application insulating film 45 filling in the concave part 41C and extends in an almost perpendicular direction against a main surface of the silicon substrate 41.

Furthermore, as described at page 12, lines 29-32, the piercing electrode 46A is formed such that it is surrounded by the application insulating film sleeve 45B in the concave part 41C. That is, the insulating film sleeve 45B lies only between the piercing electrode 46A and an inside wall of the piercing hole 41C in the semiconductor substrate 41. The insulating film sleeve 45B does not exist on an inside wall of the opening part 43C of the silicon dioxide film 43 (that is the insulating film functioning as the etching mask).

In Bertin et al., referring to Figs. 2-4 and 7, the alleged “substrate 15” is described as a semiconductor chip. The alleged “insulating film” formed on the first surface appears to be last metal layer 36. The alleged “piercing electrode 44” is described in the specification as being

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interconnect material (e.g., solder). In the device of Bertin et al., again referring to Figs. 2-4 and 7, that (26) would correspond to the present substrate, and (33) would correspond to the insulating film formed on the first surface of the substrate. Referring to Fig. 4, “through chip conductor 30” would correspond to the present piercing electrode, and “insulating material 33” would correspond to the present insulating film sleeve, the outside of which would define the piercing hole.

Thus, in Bertin et al., a diameter in the “through chip conductor 30” is same as a diameter in the “insulating material 33” while the piercing hole has a first diameter in the insulating film and a second diameter in the semiconductor substrate which is wider than the first diameter in the present invention.

Also, in Bertin et al., an “insulating material 33” lies between a “through chip conductor 30” and inside wall of a piercing hole in both “wafer substrate 26 (corresponding to the present semiconductor substrate)” and “silicon layer 28 (corresponding to the present silicon layer).” On the other hand, in the present invention, an insulating film sleeve is formed only between a piercing electrode and inside wall of a piercing hole in a semiconductor substrate.

Thus, Bertin et al. does not teach or suggest, among other things, “wherein the piercing hole is formed by using the insulating film as an etching mask,” “an insulating film sleeve lies only between the piercing electrode and an inside wall of the piercing hole in the semiconductor substrate,” as recited in amended claims 1 and 5.

For at least these reasons, claims 1 and 5, as amended, patentably distinguish over Bertin et al. Claim 4, depending from claim 1, and claim 8, depending from claim 5, also patentably distinguish over Bertin et al. for at least the same reasons.

Thus, the 35 U.S.C. §103(a) rejection should be withdrawn.

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Claims 2, 3, 6 and 7 were rejected under 35 U.S.C. §103(a) as being obvious over Bertin et al., and further in view of Hsu (U.S. Patent No. 5,841,133).

Applicant respectfully traverses this rejection.

As discussed above, Bertin et al. does not teach or suggest “wherein the piercing hole is formed by using the insulating film as an etching mask,” “an insulating film sleeve lies only between the piercing electrode and an inside wall of the piercing hole in the semiconductor substrate,” as recited in amended claims 1 and 5.

Hsu was cited for allegedly disclosing an insulating film comprised of an organic polymer. Such a disclosure, however, does not remedy the deficiencies of Bertin et al. discussed above.

For at least these reasons, claims 2 and 3, depending from claim 1, and claims 6 and 7, depending from claim 5, also patentably distinguish over Bertin et al. and Hsu.

Thus, the 35 U.S.C. §103(a) rejection should be withdrawn.

It is submitted that nothing in the cited references, taken either alone or in combination, teaches or suggests all the features recited in each claim of the present invention. Thus all pending claims are in condition for allowance. Reconsideration of the rejections, withdrawal of the rejections and an early issue of a Notice of Allowance are earnestly solicited.

If, for any reason, it is felt that this application is not now in condition for allowance, the Examiner is requested to contact Applicant's undersigned attorney at the telephone number indicated below to arrange for an interview to expedite the disposition of this case.

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In the event that this paper is not timely filed, Applicant respectfully petitions for an appropriate extension of time. The fees for such an extension or any other fees which may be due with respect to this paper, may be charged to Deposit Account No. 50-2866.

Respectfully submitted,

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